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Course scheduling and academic performance

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Abstract

This paper examines the relationship between course scheduling and student achievement, controlling for student and course characteristics. The literature in psychology recognizes that performance varies by time of day and that spacing learning out over time may foster greater long-term memory of items. We use student grades as a measure of performance and find a small, positive time of day effect partly driven by student selection into preferred course times. In addition, we find that students earn higher grades in classes that meet more often.
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1. Introduction

Duke University recently moved its earliest class time from 8 a.m. to 8:30 a.m. One motivation behind the change was to give "sleep deprived" students a chance to rest more before class. The new policy was counterproductive: the average student ended up going to class earlier since many classes were moved from the common 9:10 a.m. start time to the new 8:30 a.m. slot. Regardless, the administration used sleep as a pretext for the policy change (Carleton, 2004).

High schools have also been experimenting with changes in their scheduling, adopting block systems where classes meet for 90 min periods, instead of the traditional 50 min periods. There is evidence that block scheduling leads to improved performance (Hughes, 2004; Rettig & Canady, 1999). Block classes typically meet daily for half of the semester or on alternate days throughout the entire semester. To our knowledge, no studies have examined whether students learn more when their classes meet more often (for instance, 5 times a week instead of 2 or 3 times a week).

Duke and the block systems raise an interesting set of questions: to what extent does student learning depend on class scheduling? Do students learn more or less later in the day? Do students learn more or less when classes meet more often? The answer to these questions will help allocate school resources and plan courses to increase student learning. This paper offers some insight into the issues of offering 2-day- or 3-day-a-week classes and the timing of course offerings.

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Universities typically schedule courses that meet 2 days a week for about 75 min, 3 days a week for about 50 min, or both. The two formulas offer the same number of credit hours and class time; the 3-day-a-week schedule spreads out the materials over more days. There is a demonstrated cost advantage to meeting less frequently. However, spreading out learning into periods of shorter duration but greater frequency improves skill acquisition as well as long-term recollection of the material (Lee & Genovese, 1988; Willingham, 2002). This benefit may be greater for simpler, motor skills than more complex tasks (Donovan & Radosevich, 1999). Many studies have addressed the educational benefits and costs of block scheduling though few have documented whether changing the number of times a class meets in a week has any significant effect on learning (Rettig & Canady, 1995). If colleges reduce the number of times that classes meet to accommodate faculty preferences or to reduce costs, it is possible that student learning could suffer.

Universities choose not only how often classes meet, but also at what times. Sleep research provides three predictions about time of class and student performance. First, sleepy students perform worse than rested ones. This effect has been verified among non-traditional graduate students, Mexican undergraduates, and medical students (Austin, Fennell, & Yeager, 1988; Campos-Morales, Valencia-Flores, Castaño-Meneses, Castañeda-Figueiras, & Martínez-Guerrero, 2005; Medeiros, Mendes, Lima, & Araujo, 2003). Second, adolescents are less likely to be rested early in the morning.[1] Adolescents, in general, when faced with an earlier start to the school day, prefer to sleep less instead of going to bed earlier (Shinkoda, Matsumoto, Park, & Nagashima, 2000; Wolfson & Carskadon, 2003). Adolescents are also particularly prone to suffer Delayed Sleep Phase Syndrome: their body clock runs at a rate slower than the sun's, so they tend to go to bed late and wake up late (Dement, 1999). Third, the circadian cycle during the day and its varying wakefulness may be observed in changes in academic performance throughout the day (Carskadon, Labyak, Acebo, & Seifer, 1999; Carskadon, Wolfson, Acebo, Tzischinsky, & Seifer, 1998). Circadian rhythms are daily cycles that make people more likely to be sleepy at certain times of the day,

with wakefulness peaking at some point in the late morning and again in the afternoon.

Even articles that find no effect of sleepiness recognize the existence of adolescent sleep phase delay and discourage schools away from earlier start times (Eliasson, Eliasson, King, Gould, & Eliasson, 2002). Minneapolis high schools changed their start time from 7:15 a.m. to 8:40 a.m. Attendance rates and continuous enrollment increased and crime on campus decreased. However, the later start time did not lead to any measurable effects on grades, though the authors admit that this may be the result of data errors (Wahlstrom, Davidson, Choi, & Ross, 2001). Davis (1988) finds that 8th grade students learn more in afternoon English courses than in morning ones. Extending the analysis to college students at a small liberal arts college, Skinner (1985) documents lower average class GPAs for morning courses relative to afternoon and evening courses.

Our study uses administrative data from Clemson University, a public research university in South Carolina, to determine the effect of class schedule on student performance. Unlike Skinner (1985), we account for student ability, potential sorting across class times, course content and difficulty, class size, and the number of days per week a course is offered. In addition, we are able to observe the same students in more than one semester, giving us within-student variation in scheduling. We find that students perform slightly better in courses offered later in the day and in those offered more days per week. Given choices among class times, students select courses that best fit their scheduling preferences. This course selection accounts for part of the observed effect of the time of the class. Additional evidence suggests that the time of day effect is not driven by students' reduced attendance at early morning classes.

2. Conceptual framework and methodology

A student's grade in a course depends on many variables: the time of day, frequency of class meetings, student ability, class size, grading practices, the difficulty of the material, and teaching effectiveness. We focus on the effect of time of day and frequency of class meeting, factors typically neglected in studies of student achievement.

Psychologists provide some predictions on how class schedules may affect student achievement. Adolescents are predicted to perform poorly earlier

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[1] Adolescence typically lasts between ages 11–13 and ages 18–21 (Colman, 2001; Corsini, 1994).

in the day and circadian rhythms would create peaks in performance at some point in the morning and again in the afternoon. The earliness effect is similar for all students, while the circadian effects vary. We thus expect an earliness effect to be much more evident than a circadian effect. Distributed practice suggests more frequent class meetings should increase student learning.

We examine the effect of time of day on student grades by estimating the following grade regression for student i in section j of course c:

$$\text{grade}_{ijc} = \gamma_0 f(\text{time}_{jc}) + \delta_0(\text{no. of time/week}_{jc})$$
$$+ X'\beta + s_i + d_c + \varepsilon_{ijc} \qquad (1)$$

The vector X contains class size and whether the class meets in the fall or in the spring. Smaller classes may increase student learning, although the empirical evidence on this relationship, at least in K-12 education, is mixed (Betts, 1996; Hanushek, 1997, 1999). The student fixed effects, s_i, control for both observable and unobservable student characteristics such as ability. Course fixed effects, d_c, account for differences in course content, difficulty, and grading. The use of these two sets of fixed effects implies that any scheduling effect is net of the characteristics of the particular course or student. In all the regressions, standard errors are clustered by the start time of each class. Although grades vary for each observation, we observe many students at each class time. Clustering by class time accounts for this reduced variation.

We focus on γ_0 and δ_0, the effects of class scheduling on the student's grade. We estimate the time of day effect a variety of ways. In one specification, we include a set of indicator variables for each of the most common course times. In others, a continuous measure of start time accommodates a functional form including linear and quadratic models. The overall picture is similar for all of these specifications.[2] Spreading out course material typically leads to greater retention of knowledge than more intensive instruction, so we expect δ_0 to be positive (Bloom & Shuell, 1981).

The above framework assumes students are randomly assigned to courses. Students, however, schedule their own courses. If students register for times where they know they will perform their best, then course selection could bias the estimates. The math-phobic early bird enrolls in calculus in the morning; the math-phobic night owl enrolls in calculus late in day. Both types of students accommodate their circadian cycles by taking courses that are relatively difficult for them at preferred times. This would tend to bias downwards the time of day effect.

Alternatively, students could schedule their favorite classes in the afternoons to reduce the likelihood they skip class for more enjoyable afternoon activities. Students could take their least favorite classes in the morning to more quickly finish the hardest part of their day. Student preference for afternoons would create a positive selection bias on the time of day effect. Under this scenario, better grades in afternoon classes may reflect both time of day effects and selection effects. Student class choices would also be affected if they prefer longer classes that meet less often as opposed to shorter ones that meet more often.

The fixed effects strategy does not account for these optimizing behaviors. To better capture the true effect of time of day on student grades, we employ a differences-in-differences strategy.[3] Some courses are offered once per semester, but at different times in the fall and spring semesters. These limited offerings reduce the selection into preferred courses. Although students may defer their course-taking to later semesters to improve the scheduling match, within-semester optimizing is eliminated. To produce estimates of the effect of time of day and class meetings per week with minimal course selection, we estimate the following:

$$\text{grade}_{ijc} = \alpha_0 \text{time}_{jc} + \alpha_1 \text{one-section}_{jc}$$
$$+ \alpha_2(\text{one-section}_{jc})(\text{time}_{jc})$$
$$+ \theta_1(\text{no. of times/week}_{jc})$$
$$+ \theta_2(\text{one-section}_{jc})(\text{no. of}$$
$$\text{times/week}_{jc}) + X'\beta + s_i + d_c + \varepsilon_{ijc} \qquad (2)$$

We continue to include class size, the semester (fall or spring), student fixed effects, s_i, and course fixed effects, d_c.

One-section courses limit student selection into preferred course times. The estimated effect of time of day excluding this within-semester student selection is the sum of the coefficients on the time of day and on the interaction of time of day and the one-section indicator variable. Comparing this

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[2] We also estimate a spline specification that sets knots based on circadian cycles and regressions estimated using an ordered probit instead of OLS. The results are qualitatively similar.

[3] We thank the anonymous referees for pointing out this limitation and its potential solution.

estimate to estimates of α_0, the effect for multiple-section courses, suggests the direction of selection bias. A similar calculation provides the direction of selection bias for the number of course meetings per week.

3. Selection problems and limitations

A serious limitation is that we do not observe who teaches each course. Baird (1984) argues that a large fraction of the unexplainable variation in grading is due to differences in teachers. This affects our scheduling estimates only if instructor quality or ease of grading is correlated with course scheduling. The same instructor, for example, may perform differently at different times of day. However, Skinner (1985) provides suggestive evidence that instructors teaching the same course in a semester, once in the morning and once in either the afternoon or evening, exhibit similar differences in mean grades between the sections as between a morning class and an afternoon/evening class taught by two different instructors. Similarly, professors may prefer teaching fewer days a week and so grade more easily for those courses. This would bias downwards the estimate on number of times per week.

The quality of instructor may be correlated with course schedule. Adjunct instructors, for example, may be assigned less favorable class periods than professors who have more priority in scheduling. Adjunct professors appear similarly effective as professors (Bettnger & Long, 2006), however, adjuncts in business and finance courses give higher grades than full-time faculty (Sonner, 2000; Van Ness, Van Ness, & Kamery, 1999). If adjuncts are more likely to have morning classes or classes that meet more frequently and assign higher grades, this would bias the effect of time downwards and the effect of class meetings upwards. Course fixed effects capture some of this effect if adjunct instructors typically teach some courses and not others.

Our sample consists of mostly full-time professors, with few adjunct instructors and graduate teaching assistants. Among lower-division courses, full-time faculty members teach 62% of courses, part-time faculty members 24.4%, and graduate assistants 13.8% (SCCHE, 2005). Upper-division courses are overwhelmingly taught by full-time faculty.

If students learn more in afternoon classes, whether because of their own preferences or their professors', there is still a benefit to encouraging students to take later classes. If students learn more with more frequent course meetings, shifting towards these types of courses could improve both their grades and their education. One concern that would invalidate our results is if instructors are more apt to assign higher grades later in the day for a given student performance. This motivation would imply that later class start times would lead only to grade inflation and not improved student learning.

4. Data

To examine the effect of class schedule on a student's performance, we require data on students, courses, and class times. Clemson University (a public, doctoral, research extensive, land-grant institution in South Carolina) archives comprehensive data on its students, including every grade received and all application information. Grades are recorded without pluses or minuses as A, B, C, D, or F; we recode these as 4, 3, 2, 1, and 0. We use data from these administrative records for students in the fall of 2000 and the spring of 2001. We combine the student records with meeting time information from the schedule of classes. The time of day assigned is the start time at which a class meets most often, measured in military time. A unit increase in start time is 1 h.[4]

The unit of observation is a grade in a class. We observe 12,886 students an average of 8.2 times for a total of 105,428 grades in a class. The average student is enrolled in 14.4 credits, or just under five courses a semester.[5] The average grade is just below a B (2.97) with a standard deviation of 1.07. The average class size is 23 students. The students in the sample, averaging just over 20 years old, are slightly older than the adolescents previously studied in the literature.

Although the sample draws from only a single institution, these students are fairly average college students in the US. The median college student in 2000 was white, female, graduating at slightly lower than the top 20% of the high school class, and scoring a 505 on the SAT math test (College Board,

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[4]Results are similar if we use the average of the start and end times.

[5]We exclude labs from the analysis.

2000). Clemson students scored somewhat higher on the SAT math at 578 and are less female than most colleges, with 54% of the student body being male.

The school day begins at 8 a.m. Monday, Wednesday, Friday (MWF) classes typically meet for 50 min with a 15 min break between classes. Tuesday, Thursday (TTh) classes typically meet for 75 min with a 15 min break between classes. There are also many afternoon Monday, Wednesday (MW) classes that meet for 75 min at the MWF start times and some two-credit TTh classes that meet for 50 min.

Fig. 1 shows the average grades for each time when classes start. Most classes meet at many of the same times. The figure sizes a data point according to the number of observations represented by th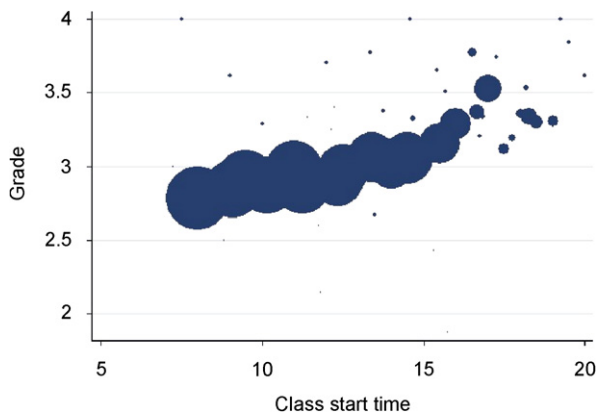at meeting time and grade combination. Focusing on the most common class times, the figure suggests a positive relationship between the time a class meets and average student grades.

Table 1 shows the average time of day for each grade in TTh courses and MWF courses. The average TTh class meets just before noon, at around 11:37. The average time a class meets is higher for A's than for lower grades. Classes that meet MWF follow a similar, although less pronounced pattern. Table 1 verifies the impression from Fig. 1 of a slightly positive relationship between time of day and academic performance. Average grades are higher for TTh courses than for MWF courses, suggesting that distributed practice may not increase learning.

5. Results

Table 2 reports OLS estimates of Eq. (1). We limit the sample to courses that meet at standard class times on MWF, TTh, or MW. These courses make up 77.4% of the full sample. The regression includes an indicator variable representing the start time of each class. For example, for MWF classes, the start times are: 8:00 a.m., 9:05 a.m., 10:10 a.m., 11:15 a.m., 12:20 p.m., 1:25 p.m., 2:30 p.m., and 3:35 p.m.[6] The omitted class time is 8:00 a.m. MWF. The change in the estimated coefficients reveals the effect of time on academic performance. As noted, we control for observable and unobservable student characteristics with student fixed effects. We also include course fixed effects.[7]

The results follow a pattern of increasing grades throughout the day.[8] As was the case in Table 1, the increase is most dramatic among TTh classes, but the pattern is consistent throughout. Although there is a positive relationship between time of day and academic performance, we find no evidence of a cyclical pattern in the relationship between time of day and academic performance.[9] Grades are highest

Fig. 1. Relationship between time and grades, all students.

Table 1
Mean start time of day for each grade

Grade	Obs	Mean	S.D.
(a) T, Th			
0 = F	1317	11.23	2.43
1 = D	2323	11.31	2.35
2 = C	7848	11.39	2.42
3 = B	14,049	11.64	2.47
4 = A	14,650	11.80	2.56
All (mean = 2.96)	40,187	11.62	2.49
(b) MWF			
0 = F	2137	10.84	1.99
1 = D	2994	10.70	1.94
2 = C	8601	10.69	1.87
3 = B	13,138	10.79	1.86
4 = A	12, 815	10.89	1.97
All (mean = 2.79)	39,685	10.80	1.91

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[6]For Tuesday, Thursday classes the times are: 8:00 a.m., 9:30 a.m., 11:00 a.m., 12:30 p.m., 2:00 p.m., 3:30 p.m., and 5:00 p.m. For Monday, Wednesday classes the times are: 8:00 a.m., 9:05 a.m., 10:10 a.m., 11:15 a.m., 12:20 p.m., 1:25 p.m., 2:30 p.m., and 4:00 p.m.

[7]We have also estimated the regressions using student characteristics instead of student fixed effects. The estimates on class time are similar to those reported here.

[8]The estimated coefficients for the different class start times are significantly different from each other and jointly significantly different from zero.

[9]More restrictive regressions using the cut-offs from expected circadian cycles also show no evidence of circadian cycles and a trend on increasing performance during the day.

Table 2
Effect of class time on student performance

Start time (MWF)	All students' grades		TTh	Estimate	t-statistics	MW	Estimate	t-statistics
	Estimate	t-statistics						
			8:00 a.m.	−0.061*	2.68	8:00 a.m.	−0.051	1.08
9:05 a.m.	0.078**	6.49	9:30 a.m.	−0.011	0.75	9:05 a.m.	−0.097**	2.45
10:10 a.m.	0.034**	2.02	11:00 a.m.	0.062**	4.09	10:10 a.m.	−0.043	0.81
11:15 a.m.	0.012**	6.86	12:30 p.m.	0.038*	2.20	11:15 a.m.	−0.032	0.81
12:20 p.m.	0.097	5.42	2:00 p.m.	0.100**	6.96	12:20 p.m.	0.025	0.74
1:25 p.m.	0.198**	10.48	3:30 p.m.	0.191**	11.26	1:25 p.m.	0.167**	4.87
2:30 pm	0.119**	4.33	5:00 p.m.	0.302**	8.30	2:30 p.m.	0.159**	9.10
3:35 p.m.	0.059	0.60				4:00 p.m.	0.202**	9.10
No. of credits	0.169	1.94						
Fall	−0.043**	4.54						
Class size	−0.0005	1.20						
Observations	81,550							
R-squared	0.30							

Robust t-statistics in parentheses. All regressions include 12,819 student fixed effects and 1109 course fixed effects, although these estimates are suppressed. Standard errors are clustered by time. The omitted class time is MWF 8:00 a.m.

*Significant at 5%.
**Significant at 1%.

in the afternoon. The benefits of distributed practice should appear in MWF classes as they meet more often. The evidence for distributed practice is mixed. Grades are lower in MWF afternoon classes than in MW or TTh afternoon classes; grades are higher in MWF morning classes than in MW or TTh morning classes.

In Table 3, we impose a functional form on the relationship between the students' performance and the start time of the class. This also allows for a direct consideration of the effect of the frequency of class meeting times. These regressions include the full sample of courses, so the number of observations is greater than in Table 2. Columns (1) and (2) present linear and quadratic specifications.

The relationship between time of day and grades is positive and significant at the 1% level. In the linear specification the effect is small. An increase in start time of 1 h is associated with a 0.023 increase in grades. The magnitude of the effect at the mean is similar in the quadratic specification. The effect of time of day increases in the afternoon, as suggested by the results in Table 2.[10] Students' grades are higher in courses taken later in the day; early morning classes are particularly bad for students'

grades. Classes that meet more often during the week tend to have higher grades. The magnitude of the effect of a class meeting an additional time each week is comparable to scheduling a class 2 h later. Grades are lower in the fall; larger classes tend to have higher grades.

The third column in Table 3 includes an interaction term of start time and the number of times the course meets per week. The coefficient on the interaction term suggests that, although later classes are significantly better than earlier classes, the benefit decreases significantly when the course meets more often. For most students, more class meetings per week involve a choice between TTH and MWF or a choice between MW and MWF. The reduced benefit from meeting more often may be a result of students frequently skipping Friday classes; lower attendance mitigates the time of day effect. Alternatively, morning classes most days may moderate the difficulty teenagers face waking up early. The interaction results confirm the impression in Table 2 that late afternoon classes are best 2 days a week while morning classes are best 3 days a week.

These estimates may be subject to selection bias. We take advantage of the two semesters of data to minimize this potential bias. Of the 1464 courses in the full sample, 1330 courses are offered only once a semester. Of these one-section courses, the university offers 234 in both semesters, 134 at different

[10]In estimates not presented here, a spline specification placing knots at times suggested by circadian cycles confirms this impression.

Table 3
Differences-in-differences estimate of time of day and class meetings per week effects

	All courses			
	(1)	(2)	(3)	(4)
Start time	0.023** (10.04)	−0.004 (0.23)	0.051** (10.02)	0.024** (10.61)
Start time^2		0.001 (1.53)		
No. of times/week	0.050** (3.55)	0.054** (3.86)	0.190** (5.85)	0.048** (3.37)
Class size	0.001* (2.59)	0.001* (2.61)	0.001* (2.31)	0.001* (2.24)
Fall	−0.032** (5.40)	−0.033** (5.47)	−0.033** (5.45)	−0.030** (5.49)
Start time × no. of times/week			−0.012** (4.88)	
One-section				0.166 (1.12)
One-section × start time				−0.011 (1.38)
One-section × no. of times/week				0.027 (0.64)
Observations	105,428	105,428	105,428	105,428
R-squared	0.32	0.32	0.32	0.32

Robust *t*-statistics in parentheses. Regressions with all courses include 12,886 student fixed effects and 1464 course fixed effects. Standard errors are clustered by time.

*Significant at 5%.
**Significant at 1%.

times in the two semesters, and 49 with a different number of meetings per week in the two semesters. With the one-section courses, students have little ability to choose preferred course times within a semester. Estimating the effects of time of day and number of class meetings per week for these classes should, in theory, reduce the effect of student selection. Identifying scheduling effects while reducing the effect of student selection relies on these 148 one-section courses offered on different days or times in each semester.

Column (4) of Table 3 presents these estimates. The time of day effect for classes with multiple sections is 0.024. In other words, taking the class an hour later is associated with a grade increase of two-hundredths of a grade point. This estimate can be divided into a time of day effect and a selection effect. With one-section courses, students are less able to choose preferred class times, eliminating the selection effect. For these courses, the effect of start time falls by 0.011 grade points, although this difference is not significant at conventional levels. We fail to reject that the effect of start time is the same in one-section and multiple-section courses. Students appear to schedule their classes in a way that improves their grades although this effect is only marginally significant.

In the same regressions in Table 3, we consider the effect of courses that meet more or fewer times per week. When the same course meets one more time per week, students' grades are 0.048 grade

points higher. We again compare the effects for one-section and multiple-section courses. For one-section courses, the effect of the number of course meetings per week is 0.027 grade points larger than the effect for multiple-section courses. Students choose to take preferred courses in sections that meet less frequently, perhaps to avoid choosing between their enjoyable class and alternate Friday activities. This selection, however, is not statistically significant. Selection appears to play little or no role in the effect of the number of class meetings on student grades.

Another possibility is that students may be more likely to skip morning classes if they oversleep. In Table 4, we show the results of a regression including an indicator for whether the class is the student's earliest class that day and an interaction term of this indicator variable and the class's start time. The results that students perform worse in their earliest classes. However, this effect is not significant at conventional levels and does not depend on how late the class meets. The time of day effect, however, persists and is similar to the estimated effect without the earliest class dummy. Students seem likely to skip their earliest class. The pattern of results, nonetheless, indicates that the time of day effect is not driven by attendance decisions.

Column (2) of Table 4 presents an alternate specification substituting the start time of a student's earliest class for the indicator for earliest

Table 4
Effect of earliest class on student performance

	(1)	(2)
Earliest class	−0.014 (1.58)	
Start time	0.021** (7.89)	0.006 (0.67)
Earliest class × start time	0.00003 (0.04)	
Earliest time		−0.021 (1.79)
Earliest time × start time		0.002* (2.22)
Class size	0.001* (2.58)	0.001* (2.62)
Fall	−0.032** (5.40)	−0.032** (5.45)
No. of times/week	0.048** (3.40)	0.051** (3.68)
Earliest class × no. of times/week	0.0002 (0.06)	
R-squared	0.32	0.32

Robust *t*-statistics in parentheses. There are 105,428 observations. Regressions include 12,886 student fixed effects and 1464 course fixed effects. Standard errors are clustered by time.

  *Significant at 5%.

  **Significant at 1%.

class. The effect of the start time of a student's first class is the sum of the earliest time coefficient and the coefficient on the interaction of earliest time and start time. This sum is positive, but not significant, indicating that the start time of a student's first class has no effect, on average, on the student's grade in his first class. Students earn lower grades in their first classes because they are first, not because they are early. At the mean, the effects of both time of day and the number of meetings per week are similar to the estimates in the base specification. However, the effect of time of day increases with the lateness of a student's first class, suggesting that students perform better in afternoon classes, particularly if they had late first classes. The results can be interpreted as a sleepiness effect. As students sleep later into the morning, their performance improves throughout the day.

6. Policy implications and conclusions

Multivariate regression analysis of the relationship between course schedule and student performance shows that students perform better in a class that meets later in the day and more often during the week. Student complaints about early classes' hurting their performance find some empirical support in this study. The magnitude of the effect, however, is quite small at 0.024 grade points per hour. To the extent that grades reflect learning, students learn more when enrolled in classes that meet later in the day and more often.

Our results suggest that students perform best in Tuesday/Thursday and Monday/Wednesday late afternoon classes. We observe benefits to distributed practice, particularly in Monday/Wednesday/Friday morning classes. The benefit of later classes, however, outweighs the benefit of more frequent classes. In other words, we find that late afternoon classes are best 2 days a week while morning classes are best 3 days a week.

Policies moving classes may have high costs. Some professors may prefer to teach in the mornings and research in the afternoons. At research schools, shifting to later class times may improve student learning but reduce research productivity. There is evidence that universities struggle with whether to offer more or fewer Friday classes. Many colleges are adding Friday classes, an underutilized day, to alleviate classroom constraints and maximize the use of their facilities (Au, 2005; Young, 2003). Shortening the school day by starting later may also strain university resources. At least one college, citing fuel costs for their commuting students, has eliminated Friday classes to reduce the number of days students drive to campus (June, 2006). Interestingly, new research suggests that college students are less likely to binge drink on Thursday nights when they have Friday classes before 10 a.m. (Wood, Sher, & Rutledge, 2007).

Given the pressure to change times and schedules, obtaining reliable estimates of their effects is not only interesting but essential for institutions of higher education to meet their goals. The findings of these studies might extend even beyond classrooms, helping firms time their production processes more efficiently.

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